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Brief communication

Possible links between osteoporosis and periodontal disease

Possíveis ligações entre a osteoporose e a doença periodontal

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Introduction

Osteoporosis leads to bone mass reduction while periodontal disease causes resorption of the alveolar bone. Both conditions have some common risk factors like smoking, poor nutritional status, age and immune deficiency.¹ The bone changes caused by osteoporosis seem to aggravate periodontal disease, however, the pathogenesis of that process is not yet fully understood.²

A possible pathway in which systemic bone loss may lead to more severe periodontal destruction is that the reduced bone mineral density (BMD), caused by osteoporosis in the alveolar bone, may facilitate local bone resorption caused by the periodontal disease.³ Another possibility is that systemic factors of bone remodeling could modify local tissue response to periodontal infection. Accordingly, individuals with systemic bone loss who have periodontitis may react differently to the increased production of cytokines and inflammatory

mediators, therefore presenting more severe periodontal disease.³

Periodontitis is an infection caused by components of the oral microbiota. Host inflammatory-immunologic responses to the periodontal microorganisms are responsible for most of the observed tissue damage, like periodontal attachment loss and alveolar bone loss.⁴ Although curable at its early stage, periodontitis remains one of the most common causes of tooth loss. Therefore, prevention and early detection of periodontal disease are essential to reduce the damages it implies.⁴

Some systemic conditions and behaviors, like poorly controlled diabetes, obesity, smoking and alcohol abuse, among others, may modify periodontal disease features. An inadequate dietary consumption of calcium and vitamin D may also represent a modifiable risk factors for this disease. Osteoporosis has been related to the severity of periodontal disease, but full explanation for this relationship is still lacking.^{1,2} The aim of this study is to review the literature on the association between osteoporosis and periodontal disease.

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The biological plausibility of the association between periodontal disease and osteoporosis

The pathogenesis of periodontal disease is a complex process because it involves host immune response to the subgingival biofilm.⁴ Periodontitis is associated with increased receptor activator of nuclear factor kappa- β ligand (RANKL) and decreased osteoprotegerin (OPG) levels in gingival tissue and biological fluids, including saliva and gingival crevicular fluid, thus resulting in increased RANKL/OPG ratio.⁵ The involvement of RANKL and OPG system is also well established in the pathogenesis of postmenopausal osteoporosis.⁶ Clinical studies have reported significant higher serum levels of RANKL in postmenopausal women with periodontal disease compared to matched subjects with periodontal health.⁶

The increased production of proinflammatory cytokines, such as interleukin IL-1 β , IL-6, tumor necrosis factor- α (TNF- α) and RANKL, are important factors in the pathogenesis and progression of periodontal disease and osteoporosis.^{6,7} As such, modulation of the expression of these cytokines may be a possible link between inflammation and bone resorption in osteoporosis and periodontal disease.⁶

Estrogen deficiency has been considered a key factor for the development of osteoporosis.⁸ Furthermore, estrogen influences the function of human periodontal ligament cells causing an increase in the OPG expression and a decrease in RANKL. Accordingly, that hormone may play an important protective role in the antiresorptive effects on human alveolar bone.⁹ The influence of serum estrogen in periodontal status of women in early menopause was identified in a longitudinal study.¹⁰ The authors observed that women with normal estrogen levels presented more biofilm than those suffering from estrogen deficiency; however they did not show increased gingival inflammation. These findings suggest that estrogen may have an inhibitory effect on gingival inflammation in patients with periodontitis.¹⁰

Estrogen importance to maintain of osteogenic differentiation through estrogen receptors in the periodontal ligament cells has been reported.¹¹ Animal studies have analyzed the influence of estrogen deficiency on the alveolar bone mass.^{12,13} A decrease in the alveolar bone mineral density was observed in sheep, six months after ovariectomy.¹² It has been suggested that the reduction of alveolar crest height observed in estrogen-deficient animals could result from higher concentrations of IL-6 within the gingiva and the adjacent bone.¹² Furthermore, increased bone loss was detected in the femur and the alveolar bone of ovariectomized rats when an animal model induced by a combination of both periodontitis and osteoporosis was used.¹³ As a result, it has been conjectured that postmenopausal osteoporosis may act as a risk factor for periodontal disease.¹³

Evidences of the effects of osteoporosis in periodontal condition

Indeed most studies that evaluated the association of low systemic BMD with alveolar bone loss showed significant

positive results.^{1,3} Systemic bone loss, for instance, showed a strong relationship with interproximal alveolar bone loss in postmenopausal women with osteopenia, thus showing that it may be a risk indicator for periodontal destruction.³

Cross-sectional studies with large sample sizes from the Women's Health Initiative Observational Study (WHIOS) indicated that the loss of alveolar crestal height is 230% higher for women with osteoporosis as compared with women with normal T-score, with increased loss for women aged over 70. Overall, there was more than 3-fold increase in the odds of worse alveolar crestal height in subjects with T-scores consistent with osteoporosis.¹⁴ For postmenopausal women aged less than 70 years, systemic BMD and oral infection independently influenced oral bone loss.¹⁵

A study comparing the periodontal status of women with and without osteoporotic fractures revealed that fractured postmenopausal women have lost more teeth and presented more advanced attachment loss.¹⁶

Studies assessing the association between osteoporosis and periodontal disease differ widely in their methodology, using samples with different selection criteria, social and demographic characteristics, techniques for periodontal examination and BMD assess. Data analysis also varies and do not always control for confounding factors. The lack of standardization for these studies may explain the discrepancies observed among the results they presented.^{1,2} Studies with larger samples and standardized diagnoses for osteoporosis and periodontal disease are needed to clarify whether osteoporosis is a risk factor to periodontal disease and, if so, to what extent.²

The influence of treatment of osteoporosis in periodontal condition

Systemic osteoporosis, low dietary calcium and low vitamin D levels may influence periodontal status and may be associated with tooth loss.² It has been reported that periodontal disease is more common in women with osteoporosis and is associated with lower vitamin D level.⁶ Accordingly, awareness of the systemic bone condition of a dental patient together with the knowledge of patient's intake of calcium and vitamin D, may be important to understand periodontal status and improve oral health.²

For subjects receiving maintenance therapy, a trend was observed indicating that those receiving vitamin D and calcium supplements have better periodontal health than those who do not have that.¹⁷ Such a supplementation of calcium and vitamin D may also imply an increase in mandibular bone mass for postmenopausal women.¹⁸ Furthermore, a cross-sectional study identified an association between plasma 25-hydroxyvitamin D concentrations and periodontal status among 920 postmenopausal women and found it to be inversely associated with vitamin D levels, gingival bleeding and chronic periodontal disease.¹⁹

Several options are available for pharmacological prevention and treatment of osteoporosis, combined with the use of calcium and vitamin D. Among them, bisphosphonates

was shown to be very effective.²⁰ Additionally, it has been observed that the use of bisphosphonates in conjunction with conventional periodontal therapy looks promising.²¹ In particular, alendronate treatment improved periodontal disease and bone turnover in postmenopausal women.²² The significant reduction in RANKL/OPG in gingival fibroblasts is on par with effects on osteoblasts.²³ Accordingly, that may play a key role in favoring inhibition of alveolar bone resorption.²³

The association of osteonecrosis of the jaws with the use of bisphosphonates has been concerning dentists. However, antiresorptive therapy for low bone mass represents a low risk for developing antiresorptive agent-induced osteonecrosis of the jaw.²⁴ On the other hand, osteoporosis is responsible for considerable morbidity and mortality. Accordingly, the benefits provided by antiresorptive therapy outweigh the low risk it brings of developing osteonecrosis of the jaw.²⁴ Furthermore, untreated periodontal disease in patients undergoing bisphosphonates therapy may lead to a higher risk of osteonecrosis of the jaws. As such, monitored dental care is recommended in order to maintain a healthy periodontal status.²⁵

Conclusion

Health care professionals and patients alike must be made aware that prevention of osteoporosis may be beneficial not only for maintaining bone health alone, but also for periodontal health. Accordingly, it highlights the role of multidisciplinary teams in supporting health. Dentists should refer patients to a doctor to enforce the treatment of osteoporosis. Likewise, doctors should feel comfortable to refer patients to a dentist for prevention and evaluation of periodontal condition. By doing so, the risk for developing osteoporosis and severe periodontal disease could be minimized.

Conflicts of interest

The authors declare no conflicts of interest.

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